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London County Council.

THE SIGNS AND SYMPTOMS OF PLAGUE.

By James Cantlie, M.B., F.R.C.S., D.P.H.

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(Ordered by the Public Health Committee to be printed.)

Public Health Department,
8, St. Martin's Place, W.C.
October, 1900.

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THE DIAGNOSIS OF PLAGUE.

London County Council,
Public Health Department.
8, St. Martin's-place, W.C.,
October, 1900.

The Local Government Board having made an Order requiring the notification by medical practitioners of cases of plague, the London County Council has thought that it would prove of assistance if a concise and accurate description of the malady, by a medical man who has had experience of it, were placed in the hands of all practitioners in London. The Council has therefore requested Mr. James Cantlie, M.B., F.R.C.S., formerly medical officer in one of the Plague Hospitals in Hong Kong, to prepare the accompanying memorandum.

Inasmuch as few medical men have had the opportunity of seeing cases of plague, the Council has engaged the services of Mr. Cantlie to visit any person in London suspected to be suffering from this disease with a view to assisting in the diagnosis. Any medical practitioner desiring to avail himself of these services should apply at this office.

Shirley F. Murphy.
Medical Officer of Health.

THE SIGNS AND SYMPTOMS OF PLAGUE.

The term plague, in former days employed to designate almost any and every epidemic ailment, has in recent years come to mean a specific disease, caused by a definite bacillus, and characterised by signs and symptoms of pronounced clinical features. Of the several adjectives associated with the name "plague," "bubonic" is the one most frequently heard; but our increasing knowledge of plague has justified the recognition of a "pneumonic" and a "septicæmic," as well as a bubonic type, each possessing signs and symptoms of a sufficiently staple pathological character to justify their recognition as true varieties. The different varieties may be classified as follows—

Varieties of type—Clinical.

Common to all varieties of plague there are certain signs, symptoms and post-mortem appearances. When, however, one special clinical feature predominates, it is usual to group the cases in which it occurs under one heading. This is convenient, and although the classification is for the most part based on clinical evidence merely, it serves further to draw attention to the many covert ways in which plague may appear, and the great difficulty in recognising its presence in every case, even when a fairly prevalent outbreak has taken place. In enumerating the types only the distinctive feature of each type is notified.

1. *Bubonic plague* is characterised by the development of a bubo or buboes during some period of the attack. It is by far the most common variety, buboes seldom occurring in less than 70 per cent. of the cases met with during an epidemic.

2. *Septicæmic plague*—No bubo occurs in this variety of the disease. During life the glands may be felt enlarged to a small extent in exposed parts, but post mortem examination shows every gland to be swollen to some extent. Septicæmic plague is very fatal.

3. *Pneumonic plague*—As the name implies the lungs are primarily affected, and so far as can be elicited by clinical examination they are the only organs which develope definite lesions. The glands are not enlarged, nor are they found swollen after death. In some epidemics the pneumonic type of the disease is more prevalent than in others. Patients with plague pneumonia seldom recover.

4. *The nervous type*—When delirium, mania, convulsive seizures, aimless wanderings, tremors, deafness, dumbness, &c., constitute prominent features of the attack, they are sometimes referred to as belonging to a nervous type of the disease. Convulsions in children and delirium in adults may usher in the disease. In children this is a fact to be remembered as the convulsions may continue to occur and the child die before other symptoms suggesting plague have developed.

5. Such terms as *toxic* and *fulminant* as applied to plague, imply a rapidly fatal issue, the patient succumbing within 24 hours; so sudden is the onset and development that the system seems paralysed in its effort to attain a reaction; the pallor of the face, the prostration, the low temperature, and the feeble pulse would seem to indicate that the person attacked is struck down as if by severe shock.

6. Cases of plague are referred to a *puerperal* type, when abortion or miscarriage has occurred. Hæmorrhages from the uterus and appendages occasionally occur independently of pregnancy. Women in the later stages of pregnancy abort when attacked by plague. After abortion due to plague few women recover.

7. *Pestis ambulans* indicates a mild type of the disease in which the patient may go about his ordinary duties. The buboes may give rise to no inconvenience and no feeling of illness. It is most commonly met in children. Several members of the household may be attacked severely by plague, but one child may escape with a painless swelling merely. This is a very dangerous type so far as infection is concerned, and a careful watch must be kept on the possible development of such cases.

8. *Pestis minor*—What is termed the larval or abortive type of plague, but which is perhaps best designated pestis minor, is an interesting form of the disease from every point of view. During many epidemics of true plague observers have recorded a mild form of the disease, which occurred not only when the epidemic was at its height, but which for several months (or years) before, and for several months (or years) after, spread amongst the community.

The importance of this ailment is that it may precede an outbreak of plague, and should be carefully watched and recorded. The symptoms are swelling of a groin gland, inflammatory effusion in the periglandular tissue, some initial fever and gradually increasing temperature, and a feeling of general *malaise*. The skin over the bubo reddens, suppuration develops, and the pus finds its way to the surface by two, three or more fistulous openings. The gland when excised is found surrounded by a thin purulent fluid, and when a section is made several small necrosed or purulent foci are seen to stud the gland tissue, which has become soft and diffluent. After removal of the gland the parts gradually heal, and by the end of a month, with the exception of a scar, all traces of the disease disappear.

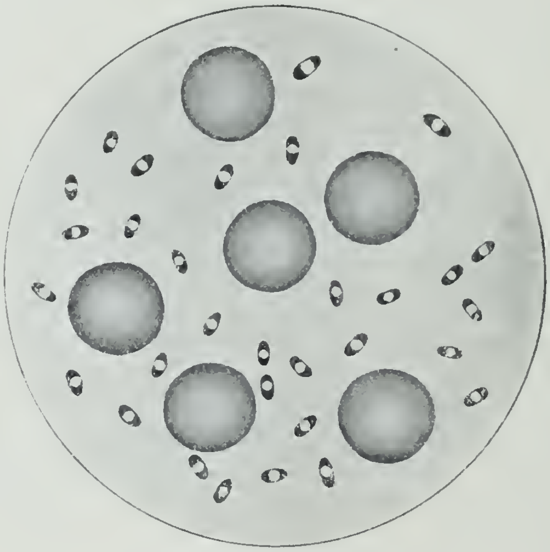
In Calcutta the plague bacillus was reported present in cases of pestis minor amongst soldiers of a regiment which arrived in Calcutta from Hong Kong whilst plague was raging in Hong Kong. It is important that cases of so-called *Bubon d'emblée*, that is buboes occurring independently of a venereal cause, should be carefully examined for plague bacilli when plague threatens or is prevalent.

THE PLAGUE BACILLUS—MICROSCOPIC CHARACTERS.

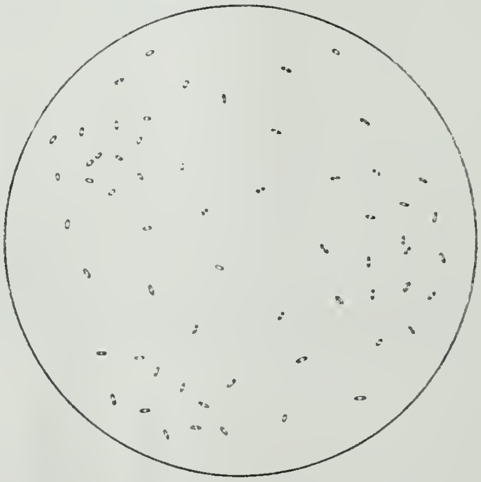
When from within a gland, or from the periglandular tissues, a small quantity of fluid is drawn off by a hypodermic (or antitoxin) syringe and examined, bacilli will be found plentifully distributed in the fluid. In the blood the bacilli may not be found until late in the disease. Search may also be made for the bacillus in the fæces, in the urine, or in the sputum of pneumonic cases. In the pus of recently opened buboes, or in the scrapings from the surface of an incised gland, a luxuriant crop will usually be found. Old standing purulent discharges seldom show the bacillus. Post-mortem, almost every organ of the body shows the presence of micro-organisms. They may be readily demonstrated when a smear from any of these sources is spread on a slide, allowed to dry, and a staining fluid added. The stain may be any one of the basic aniline dyes. The plague bacillus is a short, thick rod, with rounded ends. In length it measures about $1{\cdot}5\mu$ and in breadth $0{\cdot}7\mu$. The ends of the rod-like bacillus stain much more deeply than the centre, and around the stained portion a clear area or envelope is sometimes to be made out.

In stained preparations made from artificial culture, the bacillus may present the appearance of a diplococcus, but occasionally four to six or more of the bacilli join end to end, resembling streptococci.

DIAGRAM.



Diagrammatic representation of the plague bacillus showing its relation in size to the red corpuscles of the blood.



The plague bacillus, examined by $\frac{1}{12}$-inch oil immersion lens.

CONDITIONS AS TO THE SPREAD OF PLAGUE.

Exposure to infection—It is most important to institute a careful inquiry into the possible source of infection in every instance. This is especially important during the initial phase of an outbreak, when by its detection valuable assistance may be rendered in devising immediate steps to arrest the spread of the disease.

A ship arriving from an infected port, plague-infected rats found in a previously healthy locality, a traveller arriving by land or sea from a district or town in which plague is raging, may each and all prove to be the cause of an outbreak of the disease. The spread of the disease in a healthy town may be distinctly traced to its origin and focussed upon a particular house, as has been the case in Glasgow. How the disease reached the abode in question in Glasgow has not yet been ascertained, but that in one particular household the disease primarily developed and infected others is an undoubted fact. The importance of tracing the infection to a focus will be understood by a study of the means by which plague is spread. So far as is known it is largely by human intercourse that the plague is spread, and with this fact in view the question of dealing with all persons who have been in contact with plague-infected persons is simplified. All "contacts" must be isolated until the period of incubation is over. This is perhaps the most important point to be remembered by medical men and public authorities in their attempt to limit or to stamp out the disease.

The means by which plague is spread—Plague is spread chiefly by human agency ; but rats, body and household parasites, wounds, food and drink, and infection by the air are all possible agents in the spread of the disease.

Contact with plague-infected persons may or may not directly influence infection by plague; all depends on the circumstances and environment. Doctors, nurses, and attendants in hospitals are not markedly subject to attack, in fact the plague hospital seems to be the one place in a plague-stricken city where contagion is least potent. This is to be accounted for by the cleanliness of hospitals and by the care taken to disinfect clothing, bedding, utensils and excreta. In uncleanly abodes where disinfection, &c., is not practised, contact with persons sick of plague is dangerous in the extreme. Plague germs leave the body by way of the respiratory tract, by the fæces and by the urine. The sputum is the most directly infectious of all these, but the excreta are more likely to convey the bacillus either by soiling the clothing, the bed-room furniture, or by inoculating rats and other vermin.

Fæces are found to contain plague bacilli for four weeks after the crisis of the illness has passed, and the danger of convalescent patients mixing with the community is thus readily understood.

Clothing soiled by vomited or expectorated matters, by fæces or urine, retains infective powers for some time (months) if packed away whilst yet moist.

Food, such as grain, fruit, &c., has been found impregnated with plague bacilli, but proof that food or water has directly conveyed infection is wanting.

Rats are very prone to plague. The first warning that plague is incident may be deaths amongst rats. Plague-infected rats leave their runs, they appear dazed, become seized with convulsions and speedily die. Whether the rat is seized with plague before man and thus infects him, or whether man infects the rat, is a question as yet undecided. Many epidemics are believed to have been traced to rats, yet in other localities, and markedly so in Glasgow, the rats have not been found infected by plague, either before or after the outbreak. It is by the vermin in the rat's coat that infection is probably conveyed to man. The vermin leave the rat soon after the animal dies, and as it is found that the vermin contain the bacilli, the poison may gain entrance to the human body by vermin bites or by the abrasion of skin consequent on the scratching they induce.

Parasites, such as fleas, bugs, and lice, acquire the bacillus from feeding on plague-sick persons, or they may gather it from clothing, bedding, &c., soiled by excretions.

Infection by the air is open to question, as although the bacillus has occasionally been found in the dust of rooms, on earthen floors, and even on the walls, it has never been isolated from the air. It is conceivable, however, that in an ill-ventilated room the atmosphere may become so impregnated with the emanations from the sick as to become infectious of itself.

Entrance to the body—The plague bacillus may gain entrance by the skin, and possibly by the breath and the mouth. Entrance by the skin is considered probable for several reasons. In the first place it is the groin (femoral) glands that are most usually the seat of buboes. The selection of this group is frequently attributed to the fact that the majority of persons affected by plague in warm countries go bare-footed. Against this conclusion are the facts that skin abrasions are but seldom found, and that persons not going bare-foot have their groin glands most frequently attacked. The axillary glands, affected by way of the hands, would *a priori* seem to be more liable to such a method of inoculation seeing the hands are exposed and that soiled articles, dead bodies, rats, &c., are touched by them. Such, however, is not the case. It is possible, however, that if vermin are the intermediaries of contagion that they could settle more quietly and undisturbedly on the lower extremities, even beneath the garments, than on the more exposed parts such as the hands or face, where they are liable to be disturbed or brushed off.

Plague has been acquired by post-mortem wounds, by the sputum alighting on the conjunctiva, and in many instances the marks of insect bites and scratchings on the lower limbs would point to the skin as being the medium of entrance to the body.

Cracks in the lips and inflamed tonsils are assumed to be the mode of entrance of plague poison when the cervical glands are primarily enlarged. Proof that the bacillus can be inhaled, or that the body may be contaminated by the alimentary canal, is wanting, and however much these channels may swarm in bacilli, the mere fact does not prove that they were infected directly from without.

SIGNS AND SYMPTOMS.

Bubonic plague.

The bubonic type is taken as the standard for descriptive purposes, as the number of persons suffering from plague, in whom this variety is met with, outnumber by a large proportion those attacked by all the other varieties. Three-fourths of plague patients develope buboes.

Incubation—Three to five days is the usual period of incubation, but there is ample proof that a person exposed to plague infection may develope symptoms in thirty-six hours, or the period of incubation may extend to ten (or fourteen) days.

The prodromal symptoms are either nil, or of so indefinite a character that no specific importance can be attached to them.

Invasion—The onset of plague is sudden :—A rigor or mere chill, a splitting headache, nausea and vomiting, backache, a quick pulse, quickened breathing, congested conjunctivæ, a white coated tongue with reddened edges and tip, a rise in temperature, sudden weakness or prostration, and a marked mental disturbance, with or without glandular pain or swelling, constitute the initial indications of an attack of plague. The majority of these symptoms are common to many forms of illness, and two or three only are special. In no other disease, not even excepting cholera, does the physical strength so suddenly decline, and in no other does mental aberration develope so quickly. The presence of glandular swellings, or a bubo in combination with these, is well-nigh diagnostic of the disease being plague.

As the illness proceeds the signs and symptoms present at the onset continue or increase in severity. Vomiting may persist for a day or two or throughout the illness. The pulse at first full and rather tense, becomes weak and compressible, and towards the end in fatal cases intermittent, irregular or running. The breathing increases in rate with the rise in temperature and the quickness of the pulse. The temperature may continue to rise say from 101° F. at the onset to 103°-105°-107° F. during the first two days, or it may reach 105° F. within a few hours after invasion. After three to five days the temperature usually falls to near the normal, but after the fifth day it may rise again to fall on the seventh or eighth.

A clearer conception of plague will be gathered by a categorical study of the several organs and tissues of the body.

The digestive system—The white fur on the *tongue*, present from the beginning of the illness, speedily acquires a mahogany colour and finally changes to a brownish-black hue. At first the tongue is swollen and the edges indented by the teeth, but after two or three days the dorsum is cracked and fissured and the whole organ seems contracted in size.

The *tonsils* are usually reddened and may be swollen with mucous puncta on their surfaces; or they may be actually inflamed.

Vomiting and nausea, frequently present from the onset, may continue for a day or two or occasionally, in unfavourable cases, persist to the end. The vomited matters appear of a bilious character at first, but later on consist merely of the food and drink that has been taken, combined with an inordinate amount of clear fluid. Occasionally the vomit presents a coffee-ground appearance, but this is not due to hæmatemesis.

Constipation obtains for the most part during the first day or two; it may persist or give place to a profuse intestinal flux. On the other hand diarrhœa may be present from the onset. Blood occasionally appears in the stool.

The *abdomen* may be swollen or retracted. The *liver* is somewhat enlarged, and tender to percussion; the *spleen* is always swollen and tender, the enlargement may be such that the spleen occupies three or four times its normal size.

The circulatory system—The pulse, increased in frequency from the first, gains in rapidity as the disease progresses. At first full and tense it fails after a day or two and becomes soft and compressible and finally dicrotic or running in fatal cases.

The *heart* beat at the apex is more diffuse than normal; and a præcordial thrill may be occasionally felt. The right side of the heart shows evidence of dilatation; the first sound of the heart is short and the second feeble; a systolic murmur is occasionally present. Pulsation of the carotids is frequently apparent.

The respiratory system—In bubonic plague it is the exception to find any lesion of the organs of respiration. Should bronchial or pulmonary symptoms develope, they seldom occur before the fourth or fifth day, and usually immediately before death. The lung affections peculiar to the pneumonic type of the disease are discussed under "pneumonic plague."

The urinary system—In some epidemics it is the rule to find a trace of albumen from almost the onset of the disease; in other outbreaks, however, few urinary derangements occur. The urine is always scanty, especially at the onset of plague, the specific gravity is high, and the reaction intensely acid. Urea, uric acid and chlorides are deficient in amount; granular casts are not infrequent, and blood in some quantity is occasionally met with. In all cases retention of urine is the rule, but actual suppression may complicate the illness in fatal cases.

The nervous system—From the onset of plague the mental faculties are affected. The pain-drawn, haggard expression of countenance would seem to indicate that the patient is suffering from pain probably arising from the glandular swellings. This speedily gives way to, or may be wholly supplanted by, a peculiar listlessness and apathy of feature well-nigh characteristic of the disease. Delirium may, on the other hand, usher in the disease, accompanied by what would appear to be a suicidal tendency, inasmuch as the patient may rush to the verandah or window, to the staircase, or out into the street. The outburst is, however, unattended with any fixed idea or purpose. If gently restrained the patient is soon turned from his apparent purpose, and his aimless intention may assume the form of wandering in the street or taking passage by train to an uncertain destination. It would appear by the answers to questions that the patient is sensible, but his statements are frequently untrue, the memory being at fault. Deafness, thickness of speech, laryngeal paralysis, muscular tremor, loss of co-ordination in almost any group of muscles are common features in the disease.

Sleeplessness is a distressing symptom, and of so constant an occurrence as to constitute one of the most trying conditions to deal with. In fatal cases, picking at the bed clothes, busy delirium and coma prevail, and usually herald death.

The cutaneous system—Petechiæ occasionally appear, especially in fatal cases, over the seat of the bubo or on the limb affected by the bubo, or still more rarely on other parts of the body or limbs.

Subcutaneous hæmorrhage of an extensive character may occur around a bubo, or smaller hæmorrhages may develope elsewhere. Small patches of skin may slough, buboes suppurate, leaving foul, deep, ulcerated surfaces with ragged edges. Boils and so called carbuncles are exceptional, and a distinctive rash is very uncommon; when a rash occurs it closely resembles the rash of typhus.

The lymphatic system—The toxic agency in plague seems to expend its virulence largely on the glands. Although a bubo may be apparent in only one region of the body, post mortem examination reveals the fact that almost every gland in the body is swollen. Buboes occur most frequently in the groin, and the order of frequency with which buboes appear in the groin, axilla, and neck, stand as 50, 30, and 15, in every hundred cases which show buboes. The bubo may appear at the onset and may be present even with the initial rigor; more usually, however, it does not develope until the second day, when it will be found as a large, smooth, bun-shaped swelling. On palpation it feels resilient and rather elastic and resistant. The bubo may disappear, but suppuration is the rule at the seventh to the ninth day of the illness. The glands in the neighbourhood of the bubo are obscured and incorporated in the swelling. Œdema may extend over a wide area around the bubo, and a subcutaneous hæmorrhage may in the case of the groin buboes extend down the thigh, backwards to the gluteal region, and upwards on the abdominal wall. When the axillary glands are involved the swelling and œdema may extend over the chest, down the side to the ilium, and backwards to the scapular region. In the neck the effusion is at times sufficient to press upon the trachea and larynx.

The pain caused by the adenitis and bubo may be so great as to be excruciating, and causes the affected limb to be placed in a position calculated to best relieve tension; the lower limb is flexed on the abdomen; the upper limb placed away from the trunk, the patient lying on the back, or inclined towards, or altogether turned on, the affected side.

Septicæmic plague.

Although the term "bubonic" is usually associated with what is called true plague, it is now known that glands may enlarge and toxic symptoms develope without the formation of a bubo. The dose of poison seems so large that a general infection of the blood ensues and the patient is struck down suddenly without much chance of recovery. There is but little reaction after the onset; the pulse fails from the first; the temperature rises suddenly, it may be to a hyperpyrexic height; the prostration is extreme; delirium or coma may suddenly set in and continue to the end. The glands never attain a large size, although every gland in the body may be swollen. Deep and firm pressure may elicit pain over the groin, iliac, axillary, or cervical group of glands, but usually this is obscured by the mental condition of the patient. The septicæmic type is a very fatal variety of plague.

Pneumonic plague.

During the epidemic of plague in Bombay in 1896 attention was drawn by Childe to the abnormal number of deaths returned as 'pneumonia'. A bacteriological investigation of such cases showed that the plague bacillus was present in the sputum in almost a pure culture, and since that time the pneumonic variety of plague has been recognised as a distinct and very fatal form of the disease. The symptoms are—expectoration of a quantity of watery sputum, frequently tinged with blood, and occasionally some frothy mucus; hurried or laboured breathing, cardiac discomfort, restlessness, sleeplessness and early delirium. The local signs are patchy, irregular, pneumonic consolidation of the lungs, congestion of the bases, and intermittent evidences of bronchial catarrh. Buboes do not occur, nor are the glands found swollen either during life or after death.

Duration of the disease.

The most fatal period in bubonic plague is from the fifth to the seventh day, but death may take place earlier or later. Suppuration of the bubo and bursting of the abscess occurs usually between the eighth and twelfth day, and should the patient survive until that period the chances of recovery are hopeful. In septicæmic plague the patient has much less chance of recovery. Death may occur in thirty-six hours or may be delayed until the fourth or fifth day. Few recover from this variety of plague. From the pneumonic variety of plague few recover; death usually occurs from the third to the fifth day. Convalescence in every instance is very slow; the patient is unfit for sustained physical or mental work for several months after an attack of plague.

Diagnosis.

Conclusive proof that a person is suffering from plague can be arrived at only by proving the plague bacillus to be present in the excretions, in the glands or periglandular effusion, or in the blood. But clinical evidences are usually sufficiently pronounced to suggest that the illness is due to plague. The sudden onset, the marked prostration, the mental aberration, the splitting headache, vomiting and nausea, backache, the rise in temperature, the furred tongue, when taken in conjunction with tenderness and pain in some one of the groups of glands are sufficient to indicate the necessity for a speedy microscopic search for the plague bacillus.

Pneumonic plague is apt to be regarded as simple pneumonia. The rapidity of the development of all the signs and symptoms are, however, peculiar to plague infection. The early delirium, the early signs of patchy pneumonia, the presence of blood in the expectoration from almost the onset, combined with extreme prostration would seem to indicate a specific form of illness. "Glandular" fever in children is apt to be mistaken for plague during an epidemic. Convulsions in children may usher in an attack of plague. Typhus fever, although an uncommon disease, presents several of the signs and symptoms characteristic of the plague, but typhus fever developes more slowly; the rash is unlike the plague petechiæ which are occasionally met with; the prostration and the delirium come on at a later stage of the disease. Typhoid fever even may be confounded with what is called the "typhoid" variety of plague, but a 48 hours' study of the temperature will generally suffice to differentiate the diseases.

Prognosis.

The chances of recovery in individual cases are well nigh incalculable, as the most favourable appearances are sometimes delusive, and the most hopeless-looking cases may recover. In China, among patients under treatment by Chinese "doctors," over 95 per cent. of those attacked died. In India, 70 per cent. of natives who were attacked by plague and were, more or less, under European treatment died. Amongst white people the death rate is much less; about 35 per cent. only died in India. In Sydney, 103 persons died out of 303 attacked.

PATHOLOGICAL ANATOMY.

Bubonic plague.

An examination of the surface of the body of a person dead of *bubonic* plague may reveal petechiæ, bites and scratchings, and less frequently boils and 'carbuncles'. The situation of the bubo is generally readily apparent. On examining a bubo that has not formed an abscess and broken, there will be found around the bubo a large accumulation of perivascular inflammatory effusion extending some way, it may be great way, in the surrounding tissues, or an extensive hæmorrhage may be found. The glands involved will be found matted together by tissue infiltrated with serum, coagulated blood or inflammatory fluids. One gland of the group may be found as large as a walnut, the others varying in size from a bean to a hazel nut. All the glands are intensely engorged, the smaller on section appear dark in colour, the larger of a bright red or even pink tinge. In consistence, the less swollen glands may be almost normal, but the more enlarged are soft and diffluent to the touch. As a rule every gland in the body is swollen to some degree, and not only is this true of the limb glands but the lumbar, the mesenteric and the mediastinal glands may be all involved.

The respiratory organs in bubonic plague are not deeply affected, but subpleural petechiæ and hæmorrhage both parietal and visceral are frequently seen. The cavity of the pleura always shows a fair amount of pleural fluid which may be occasionally blood-stained. The lungs are œdematous, intensely congested and minute hæmorrhages may be seen in their tissues. A frothy mucus, occasionally blood-tinged, occupies the bronchi.

The heart and pericardium—Petechiæ on the parietal and visceral layers of the pericardium are commonly met with, and some two or three ounces of fluid, occasionally blood-stained, occupies the cavity of the pericardium. The heart muscle appears flabby, and the tissue cloudy as if from fatty degeneration; the right side of the heart is usually dilated, and the walls of the great veins approaching the heart show small subendothelial hæmorrhages in their coats.

The abdominal viscera—Beneath both the parietal and visceral layers of the *peritoneum* hæmorrhages are to be seen. Retro-peritoneal hæmorrhage, hæmorrhages into the mesentery and omentum at times attain wide dimensions, and around the kidneys the largest of all extravasations of blood occur. The *mucous membrane* of the stomach and intestines are deeply congested, petechiæ are common, and occasionally considerable hæmorrhages. The solitary glands and Peyer's patches are always prominent, and sometimes even ulcerated. The *liver* is intensely congested, increased somewhat in size, the tissue pale or brownish red on section, and the parenchyma, if altered at all, softened. The gall bladder is generally found full of bile, and around it a hæmorrhage may be found. The *spleen* is swollen to three or four times its normal size; hyperæmia is usual, and the colour of the organ varies from bright red to deep purple. Hæmorrhage may occur beneath the capsule and extend for some distance into the splenic pulp.

The kidneys are found enlarged, deeply congested, and occasionally embedded in a mass of coagulated peri-renal blood. The capsule is easily removed, the stellate veins are prominent, and small hæmorrhages occur between the capsule and the kidney surface. A thickened cortex and a cloudy swelling of the renal substance are apparent on section. Blood may occupy the renal pelvis, and both the ureter and the bladder occasionally contain blood. The bladder may be distended with urine or quite empty, and the mucous membrane may or may not show petechiæ.

The nervous system—Meningeal congestion, engorgement of the cranial vessels, œdema, and distinctly marked vascular puncta in the brain substance, are almost constantly met with in plague. Ecchymoses in the pia mater occasionally occur. The spinal cord and the nerve trunks show no pathological changes.

Septicæmic plague.

The special post-mortem characteristics of this variety of plague are confined to the state of the glands. There are no buboes, but practically every gland in the body is swollen in some degree. In one group and in one gland of the group adenitis is more advanced than in others, but all show signs of engorgement on section. They are of a pink colour and firm in their consistence, although in the largest glands areas of softening are apparent.

Congestion of viscera, subendothelial and submucous hæmorrhages and petechiæ occur in the septicæmic form of plague; but there is no periglandular effusion or hæmorrhage to be found. It would appear as though the intensity of the poison is so virulent and its diffusion so general that the patient is carried off before the bubo had time to develope, for this is a most fatal form of plague.

Pneumonic plague.

The pathological changes in the pneumonic variety of plague are almost wholly confined to the respiratory organs. It is quite exceptional to find any gland enlarged, but occasionally the bronchial glands appear swollen. The changes presented in the lungs are:—Œdema, venous engorgement, patches of pneumonic consolidation irregularly distributed and varying in size from a hazel nut to a good-size apple. Around the reddish-grey or claret coloured patches a circle of crepitant and engorged lung tissue exists. Subpleural hæmorrhages are usual. The bronchial, the tracheal and laryngeal linings are reddened and injected; a frothy, blood-stained fluid occasionally occupies their lumen. The cerebral, the cardiac and abdominal changes resemble those mentioned as occurring in bubonic plague.

James Cantlie, M.B., F.R.C.S.,
Lecturer, London School of Tropical Medicine.